FM 3 Stereo Tuner
Service Manual
QUAD FM 3 TUNER
service supplement

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ALIGNMENT PROCEDURE - 1

General
To achieve the specified performance this alignment procedure should be followed closely. Alignment should not be attempted without the equipment listed below.

Equipment required:
1. 10.7 MHz watch modulator with a maximum output of 100µW rms.
2. Oscilloscope with a maximum Y sensitivity of 10mv/cm and D.C. coupled Y amplifier.
3. VHF signal generator covering the range 88-108MHz, with AM and FM modulation facilities and an attenuator accurate at power levels of 2µW (e.g. the Radiometer M277).
4. Stereo signal generator with both multi-level audio and multiplex RF outputs (e.g. the Radiometer SIMG1).
5. Harmonic distortion meter or 1kHz notch filter.
6. Detector probe (a suitable circuit is shown in Fig. 1).

Filter coding
Two versions of the ceramic filter have been used and can be interchanged providing the necessary alignment adjustments are made. The original type CF10.7MA has a black body and is colour coded to indicate centre frequencies as follows:
Green 10.62 ± .03MHz
White 10.74 ± .03MHz
Blue 10.66 ± .03MHz
Red 10.70 ± .03MHz
Yellow 10.78 ± .03MHz
Orange 10.64 ± .03MHz
Red 10.70 ± .035MHz
Yellow 10.78 ± .035MHz
White 10.64 ± .035MHz

Note that types CF1 and SF1 carry the colour code spot at their input end but type SFJ carries it at its output end. The lead-out wires of SFJ are in line but may be bent to fit without rebalancing board for service replacement.

HT Voltage adjustment
From serial number 5885 onwards no HT voltage adjustment is provided. On earlier models positive and negative supplies were adjusted to 14 volts by means of RV102 and RV104 respectively.
IF Alignment—before serial no. 10,000

Connect the detector probe to test point D, inject a modulated 10.7MHz signal at test point C, and observe the probe output on the oscilloscope. Throughout the following procedure progressively reduce the modulator output as necessary to maintain an oscilloscope display amplitude of approximately 60mV peak to peak.

If a 10.7MHz crystal oscillator is available it may be injected at the appropriate probe terminals to provide a marker. Adjust both cores of IPT1 simultaneously for maximum response.

Adjust the core of L5 for maximum response.

Make small adjustments to IPT1 and L5 cores as necessary to obtain the response shown in Fig. 2.

Remove detector probe from test point D and transfer oscillator output lead to point B (Pink interconnection lead). Adjust core of discriminator coil L6 for maximum slope of the centre portion of the discriminator characteristic.

Transfer probe to test point A and unshield the filter input pin (pin 1). This is necessary since the response at this point (Fig. 5) is dominated by the filter input impedance. It should be noted that the peak response at this point does not correspond with the filter centre frequency.

The response at test point A with filter removed is shown in Fig. 4 and should show no signs of double humping. If it does it will be necessary to replace IPT1.

If responses: As a rough check of performance after completing the IF alignment, connect the trace signal to obtain the amplitude shown in Fig. 4, when the amplitudes shown in Figs. 2, 3, and 5 should also be obtained.
IF Alignment—serial no. 10,000 onwards

Connect an oscilloscope to Test Point D (pin 13 of CA1006), and inject a modulated 10.7MHz signal at 50% modulation depth into TP4 for maximum amplitude at test point O. Fine adjustment of the core will then enable the maximum width of the flat top to be obtained as shown in Fig. 2, with a minimum of generator output.

Transfer oscilloscope lead to test point R and adjust core of L8 for maximum slope of the linear centre portion of the discriminator characteristic.

RF Circuit Alignment—before serial no. 10,000

After completing IF alignment remove modulator input but leave detector probe at test point A.

Connect the RF generator to the aerial socket and inject a 300µV 75% amplitude-modulated signal at 90MHz. Present the cores of L1, L2, L3 level with the tops of the formers, and the trimming capacitors C1, C8, C30 approximately three threads out.

Check that pointer travel is symmetrical about end scale markings, and that pointer is fixed to stinger. (If necessary secure with spot of DuriFix or similar adhesive).

Set the tuner to 90MHz and adjust the cores of L1, L2, L1 in that order for maximum amplitude of oscilloscope display. If the front end of the tuner is badly misaligned it may be necessary temporarily to increase the generator output slightly. Caution should be exercised since it is possible to align to a spuriously high level if too high an input level is used.

Return generator and tuner to 104MHz and adjust L8, C9 and C1 in that order for maximum response.

Repeat adjustment of cores and trimmers until no further improvement is possible.

Remove probe, modulator filter pin 1 and connect oscilloscope to test point R, together with valve voltmeter. Inject 3µV 90MHz 50% FM at aerial socket.

Return tuning to 90MHz observing the oscilloscope. The correct tuning point occurs with no interference showing equal amounts on positive and negative peaks of the audio output.

Make small adjustments to the core of L8 to obtain maximum audio output level as observed on the voltmeter. Set RV2 for equal brilliance of the tuning lamps.
RF Circuit Alignment—serial no. 10,000 onwards

Since a demodulated output is available at test point G, no detector probe is required with these sets unless a fault is suspected prior to the CA2088. RF circuit alignment then follows the procedures outlined above as for earlier models.

Adjustment of Noise sensing coil L4
Adjustment of this core should be unnecessary unless it is not possible to mute signals below 100µV.

If alignment is necessary, connect a suitable variable attenuator to the audio output socket and the FM generator to the aerial socket. Unscrew the core of L4 until level with top of core.

Inject an FM signal of 10µV and advance the mute control to the point just prior to muting. Screw the core of L4 in until muting occurs. Increase the signal level until the tone comes out of muting and then progressively reduce the signal level in small steps. Recording the appropriate signal level will indicate the degree of improvement possible.

This completes the RF board alignment with the exception of L7 which must be aligned in conjunction with the decoder.

Decoder—before serial no. 5885

Remove the pink inter-loader lead from the decoder and inject a 19kHz pilot tone at a level of 30mV from the multiplex generator.

Connect the valve voltmeter by means of unscreened cable to the tap on L101. Adjust the core of L101 for maximum output. L102 and L103 are aligned in a similar manner with valve voltmeter connected to their respective taps.

Connect the distortion meter input to the output socket Pin 5 and tune the distortion meter to 19kHz. Observe the distortion meter output on the oscilloscope which will show the residual 38kHz switching components together with the multiples of harmonics. Adjust the core of L104 for minimum value. Similarly connect the distortion meter to Pin 3 and adjust L105.

With the distortion meter still connected to Pin 3, apply a stereo signal modulated with 1kHz on right channel only and adjust RV101 for minimum crossover. Slight adjustments of L101 in conjunction with RV101 may be necessary to achieve a small second harmonic component to be reduced to a small second harmonic component.

Again, observe the distortion meter output and progressively reduce the pink interconnecting lead. Inject at the serial an FM stereo signal carrying right channel modulation at 1kHz.

Again observing the distortion meter output adjust the core of L7 for minimum crossover.

As a check on these last three separation adjustments apply 10kHz right channel modulation and measure crossover which should be better than —30dB.
Decoder—serial no. 0885 onwards
The decoder uses two 7404G integrated circuits providing improved stereo separation and lower distortion.

The only adjustment provided is RV100 which sets the free run frequency of the oscillator contained within IC100. For this adjustment either connect a digital frequency meter to test point S (pin 10 of IC100) where the 19kHz square waveform appears, or if an accurate 19kHz source is available, such as the pilot tone from a stereo generator, connect this to the X amplifier of an oscilloscope, test point S to the Y amplifier, and use the neon bulb signal on each channel as the test tone for the IC100. The sound output is muted in the decoder by muting the set, for this adjustment only.

With a distortion meter connected to the output socket pin 3, apply an FM stereo signal carrying pilot tone only to the aerial socket. Tune the distortion meter to remove the 19kHz from the output signal so that the heatabsorb element is measured when applying a 1kHz signal on the right channel only. The value of L7 is then adjusted for minimum output distortion. Alternatively this adjustment may be performed with comparable accuracy by listening to the output.

ALIGNMENT PROCEDURE – 2
USING SOUND TECHNOLOGY 1000
TEST EQUIPMENT

Alignment is in three parts: RF, discriminator and decoder.

Part 1
Connections
Sound Technology 1000 HD202 to X-Y1
Sound Technology 1000 RF out to tuner aerial input
Test Point D to Y-Y2 via clip lead
Crystal meter generator loosely coupled to tuner aerial
Input via 470Ω Resistor
Mains to tuner

Controls
SCOPE TO XY
X—6v/Div DC coupled
Y—5v/Div DC coupled
Sound Technology 1000 FUNCTION—DUAL SWEEP
SWEEP WIDTH—700 to 90kHz
RF Level—30V
Input—Mono

(4) Tune tuner to 60MHz
Tune Sound Technology 1000 to 90MHz
Adjust L3 to locate IF response
Adjust L2 for maximum gain
Adjust L3 for maximum gain
Adjust IF1 for optimum shape and gain
Switch on 90MHz marker, and adjust L3 to centre marker on peak of IF response
Switch off 90MHz marker

(b) Tune tuner to 100MHz
Tune Sound Technology 1000 to 106MHz
Switch on 106MHz marker
Adjust C17 to centre marker on peak of IF response
Switch off 106MHz marker
Adjust C15 for maximum gain
Adjust C1 for maximum gain

(c) Repeat a
(d) Repeat b
(e) Repeat a

When it is clear that alignment is correct and gain is optimum at both frequencies, reduce sweep width to 20kHz and confirm that sweep is centred accurately.

Part 2
Connections
Sound Technology 1000 HORIZ to X-Y1
Sound Technology 1000 VERT to Y-Y2
Test Point R to RCVR via clip lead
Right channel audio out to voltmeter input

Controls
Scope X 5v/cm DC
Scope Y 0.5v/cm DC
Sound Technology 1000 FUNCTION—DUAL SWEEP
SWEEP WIDTH—200kHz
RF level—1000uV
VOLTMETER—500mV

(a) Adjust L4 to give symmetrical display
(b) Adjust RV2 to obtain equal brightness of tuning lamps

Reset controls
Sound Technology 1000—
FUNCTION MONO/STEREO
Sound Technology 1000—INPUT MONO
Sound Technology 1000—OSC LEVEL TO 79%
Adjust RV3 to obtain 250mV rms audio output
Check level is the same for left channel and mono outputs.
(c) Signal to noise check
Controls
Sound Technology 1000
RF LEVEL 4µV
FUNCTION—CW
Output level should drop by 40dB

Part 3
Connections
Sound Technology 1000 1kHz to Y1
Test point S to Y2 via clip lead
Right channel audio to voltmeter input

Controls
Sound Technology 1000
FUNCTION—STEREO
OSC LEVEL MINIMUM
RF LEVEL 1000µV
PILOT LEVEL MINIMUM

Scope
Y1 2v/cm
Y2 2v/cm
TIMEBASE 1μS/cm
TRIGGER Y1

(d) Adjust RV100 to obtain 1kHz signal on Y2

(b) Increase PILOT LEVEL on Sound Technology 1000
and confirm that 1kHz signals lock and esw20 lamp
illuminates at 5 to 6% pilot level.

(c) Set PILOT LEVEL to 9K
(d) Reconnect—Y2 to voltmeter output via clip lead
Y1 to left channel audio.

Controls
Sound Technology 1000
INPUT—Left
OSC LEVEL—100%
VOLTMETER 5mV, 10kHz to 10kHz
SCOPE Y1 2v/cm
Y2 2v/cm
TIMEBASE 0.2μS/cm
TRIGGER Y1

Adjust LT for minimum crosstalk signal in right channel
(less than 3mV)

Alignment is now complete but several checks still have
to be made.

(1) Having checked left to right crosstalk, check right to
left by connecting left channel audio to voltmeter input
right channel audio to scope Y1
switching Sound Technology 1000 INPUT to RIGHT
(2) Check the mono output connect mono output to voltmeter input. Switch Sound Technology 1000 INPUT to L + R confirm that mono output level is approx. 330mV at 100% modulation. Switch Sound Technology 1000 INPUT to L - R confirm that mono output level is less than 5mV.

(3) Check muting function. With the muting control on the tuner turned to maximum, reduce RF level on Sound Technology to 200μV and adjust L4 so that the tuner just mutes.

MODIFICATIONS

RF Board

From Serial No. 540 onwards

1. New L5 coil coded yellow.
2. L5—modified* and mounted with colour spot to R16.
3. M34, M35 removed and replaced by 4K7 resistors.
5. R32 removed.
6. C32 changed from 33pF to 18pF.
7. R13 changed from 680Ω to 1K.
9. C34 changed to 47pF.
10. C47, 47μF added.

From Serial No. 1500 onwards

Issue 4 printed circuit board M12248

1. R37 added.
2. L5 unmodified* as per 540.
3. R32 restored (see parts list re value).

* Modification to coil L5 comprised cutting off the unused centre legs to permit re-orientation.
The following modifications have been made at various stages in production from serial no. 3000 onwards:

1. Panel lamp series resistor changed from 100 ohms to 68 ohms to improve lamp life.
2. TR4 changed from 40244 to BF44 or BF357.
3. C13 and C15 changed to 1000 ohms in a modification which results in improved background noise.
4. C26 changed from 3.3µF to 4.7µF consequent upon change of TR4 to BF357.
5. TR1 may be 3N201.
6. TR2 may be 3N205.
7. TR10 and 11 may be MPSA12.

M12248 Issue 6 Printed Circuit Board

1. Tuning gang changed from Wingrove & Rogers C380 to DAU-338/50—N.B. These gangs are not inter-changeable and when obtaining spare parts it should be made of the tuning scale fitted. With Wingrove & Rogers gangs the legend MHz appears verbally and with DAU gangs it is at the right end of the scale.
2. Chassis changed from Issue 6 to Issue 7.
3. Tuning drive changed.

M12248 Issue 7 Printed Board

As Issue 6 except tuning gang is Wingrove & Rogers CG80. Scale is B12333, C7 is 150µF and C18 is 25µF.

M12248 Issue 8 Printed Board

As Issue 6 except TR10 and TR11 are each changed from 1N5306 to 2N5108 or 8C184K.

M12327 Issue 1 Printed Circuit Board, Serial No. 10,000 onwards

IC1, IC2, TR3 are removed and replaced by CA3088E as shown on relevant circuit diagram. If necessary the audio output from this board may be increased by modifying as Issue 2 and setting RV2 for 100mV RMS output at 22kHz deviation.

5. Variable Resistor RV3 added.
6. R38 10kΩ added.
7. Oscillator configuration altered resulting in:
   (a) L3 changed from 2 terminal to 3 terminal
   (b) C25 changed from 0.02 to 0.05µF
   (c) C18 changed from 20µF to 18µF
8. Core of L1, L2, L3, changed from 2 Neovolt 800 and 1 Neovolt 910 (L3) to 3 type 900.
9. L4 and L7 changed from 6.8, Stock No. 750G to Toko type CAN 990 6X, Stock No. 750G.
10. C7 changed from 15µF to 13µF.
M12327 Issue 2 Printed Circuit Board

- Link between pins 7 and 10 of CA3088E removed and pins 6 and 7 linked instead. R29 and R31 changed to Zn. This board was also redesigned to accommodate Jackson type C23 gang from serial no. 18900.

M12327 Issue 3 Printed Circuit Board

- Drilling changed to accommodate Toko filter SFL107 MA2.

Decoder

- From Serial No. 540 onwards:
  - R102 removed
  - C105 changed to .015µF
  - L102 modified
  - R126 changed to 180Ω

- From Serial No. 950 onwards:
  - R101 changed to 180Ω

M12247 Issue 2 Printed Board

1. L101-8 changed from G.B. Stock No. 780G to Toko type CA61900B0X. Stock No. 790G—these are not interchangeable.

2. C105 changed from .015 to .01µF.

3. Diode type IS820 added between pin 2 of IC101 and block interboard lead (Anode of diode to pin 2). This reduces background noise when set is muted.

4. Alternative Transistors
   - TR103—BC143 changed to BC461 or BC303.
   - TR102—BC164K or BC109C.
   - TR103—BC164 or BC146C.
   - TR105—BC184K, BC109C or ES270.
   - IC101—MC1305P or SN76105.

M12307 Issue 2 Printed Board

- From Serial No. 5885 onwards:
  - IC101 changed to MC1310P or SN76115.
  - No coils.
  - Power supply altered to eliminate HT setting pots.

Alternative transistors

Early tunes used type 40673 for both TR1 and TR2. For replacements use type 40822 for TR1 and 40823 or SN205 for TR2.
INSTRUCTIONS FOR REPLACING DRIVE CORD

See Fig. 5A for tuners fitted with Wingrove & Rogers tuning capacitors or Fig. 5B for tuners with Dau or Jackson tuning capacitors.

Use nylon braided glass cord cord such as Fiskars size 20. Ensure that it does not come into contact with lubricant on pulley spindles.

Remove front panel (4 screws) and tuning drum (2 grub screws). For tuners with Wingrove and Rogers capacitors take 16 inches (40 cm) OR for those with Dau capacitors take 26 inches (66 cm) of cord, knot one end and items, then thread through hole (3).

Take another length of cord, 30 inches (76 cm) long for Wingrove and Rogers OR 12 inches (30 cm) for Dau, knot one end and items, then thread through hole (6) to outer edge of tuning drum (1) and through hole (7).

Turn tuning capacitor to fully closed position and replace tuning drum in position shown in Fig. 6. Lay the shorter length of cord around drum one turn in clockwise direction to pulley 3 for Wingrove and Rogers OR in anti-clockwise direction for Dau, towards pulley (5). Attach free end of cord to spring (4), so that spring is approximately ⅜” from pulley (5). Remove surplus cord and loop free end of spring temporarily to pulley (5) spindle.

Take the other length of cord, and lay around tuning drum, 2½ turns in anti-clockwise direction for Wingrove and Rogers OR 1½ turns in clockwise direction for Dau, to capstan (8). Then 2 turns around capstan in clockwise direction to pulley (9), and around pulleys (10) and (8). Attach cord to few end of spring, extending spring about 25% and remove surplus cord.

Replace front panel, then with tuning capacitor fully closed, replace pointer (11) so that it lies at tuning knob end of scale line.